Cup b

THE JOURNAL OF EDUCATIONAL SOCIOLOGY

NUCLEAR ENERGY

Lillian Wald Kay, *Issue Editor*

JANUARY 1949

THE JOURNAL OF EDUCATIONAL SOCIOLOGY

PUBLISHED BY

THE PAYNE EDUCATIONAL SOCIOLOGY FOUNDATION, INCORPORATED

32 WASHINGTON PLACE, NEW YORK 3, N.Y.

THE JOURNAL OF EDUCATIONAL SOCIOLOGY is published by The Payne Educational Sociology Foundation, Inc., monthly from September to May, inclusive. Publication and business office, Room 52, 32 Washington Place, New York 3, N.Y. Editorial office, Room 41, 32 Washington Place, New York 3, N.Y. The subscription price is $3.00 per year; foreign rates, Canadian and South American, $3.25, all others, $3.40; the price of single copies is 35 cents each. Orders for less than half a year will be charged at the single-copy rate.

Entered as second-class matter September 27, 1934, at the Post Office at New York, N.Y., under the Act of March 3, 1879.

THE JOURNAL OF EDUCATIONAL SOCIOLOGY is indexed in *Educational Index, Public Affairs Information Service*, and *Business Education Index*.

tor

THE JOURNAL OF
EDUCATIONAL SOCIOLOGY
A Magazine of Theory and Practice

Vol. 22 January 1949 No. 5

EDITORIAL

Perhaps it is an omen of things to come that the editors of this issue, who represent the field of natural science and the field of social science, should collaborate to tell the story of atomic energy. It is, in itself, an indication of the interest and participation of all disciplines in showing why people are, and should be, interested in nuclear energy. Such pooling of knowledge is the first step toward an integration of the contributions of all the disciplines to serve human needs.

The contributors have told a magnificent story which says that not only have the techniques of producing more technology been mastered but these techniques are changing the traditions of our society as well.

The proposals today are those which evolve around the human equation: man and his social institutions. This is where education and the educator come in.

DAN W. DODSON

PEOPLE SHOULD LEARN ABOUT NUCLEAR ENERGY—A SERIES OF EDITORIALS

I. Lt. Gen. Leslie R. Groves, U.S.A. Ret.

The successful development of the atomic bomb by the Manhattan Project placed a permanent milestone in the history of the world.

The use of the bomb against Japan brought to a sudden end the greatest war in history and thus saved hundreds of thousands of American casualties as well as untold suffering to the people of Japan.

The American people can well take pride in the success of their Manhattan Project, for it was their project in every sense. It demonstrated the power of a unified governmental effort. But it could not have been accomplished without the managerial ability of the American system and the strength of our way of life. Nor could it have been accomplished without the industrial capacity of the United States, without the skill of American labor, or without the knowledge of and ability to apply that knowledge by the engineers and scientists of this country. The aid of foreign countries must also be remembered, not only our English, Canadian, and Belgian allies but also our enemies, Germany and Italy. The contribution of the latter was their restrictive policies which encouraged a number of distinguished nuclear scientists to become American citizens.

Enough of the past — let us talk about the present and the future.

Our country has been at peace since V-J day without surrendering our principles, primarily because we had the atomic bomb as our greatest military strength. We must, if we are to be intelligent citizens, understand the national and international problems sufficiently to ensure that our Amer-

ican policies will remain wise, strong, and American in every sense of the word.

We must ensure also that we remain in the lead, and by our present great margin, in the atomic sciences.

From the day that I was placed in charge of the atomic project the hopes were ever-present for the fullest possible beneficial uses of our hard-won knowledge.

The need for the great security measures which surrounded the development of the atomic bomb during the war days still exists. Much, however, can be disclosed without impairing our national security. Such disclosures should all be aimed at increasing our capacity, as a people, for further progress along the road toward the fulfillment of our hopes for the full development of the beneficial uses of atomic energy. We should aim at informing the American people of the basic principles of this new field in scientific research. This can be done without impairing the security of the weapon aspects which must be kept secret as long as we cannot be assured of a lasting peace.

The people will live with and profit by nuclear energy. It is our obligation to explain it to them in order that ignorance and fear may become healthy respect. This understanding will increase our national development of nuclear energy for peacetime purposes.

The industrial and scientific uses will be developed by great engineering and chemical corporations similar to those which were of so much value in making the weapon possible.

Much that has been written about atomic energy has inspired fear and confusion in the minds of many. This is not a healthy state of affairs. Atomic energy must be explained. The average American likes new scientific devices. He must learn that nuclear energy, like fire and electricity, can be a good and useful servant.

We must protect what should be our country's most carefully guarded secret. As citizens it is equally true, however, that we must exert every effort to spread the base of educa-

tion. An intelligent population is the greatest safeguard to national security and the best incentive to a better life that this country has. An informed population is an alert one.

A possibly great future source of well-being in the United States, as well as in the world, lies in the development of nuclear energy. This will take tremendous amounts of man power and skill. By creating an interest among the people, particularly the youth of our nation, we are fostering the curiosity that leads to study and invention, both of which are essential to the development of this great new tool. We came this far in atomic research because we had the world's greatest combination of industry, science, and managerial ability. We will keep the lead if we spread the present fund of information, within security limitations, and foster the search for facts. This is our duty to our country and its people.

Leslie Richard Groves, Lt. Gen., U.S.A. (ret.), was wartime head of the Manhattan Engineer District. He continued in full charge of the atomic-bomb project until the civilian Atomic Energy Commission was established on January 1, 1947. General Groves commanded the Armed Forces Special Weapons Project (a joint Army-Navy-Air organization responsible for the atomic-energy matters still remaining in the hands of the Armed Forces) until February 1948 when he retired. He is now vice-president in charge of advanced scientific research of Remington Rand Inc.

II. Rear Admiral William S. Parsons, U.S.N.

Some years ago I was in a division of destroyers maneuvering off San Diego, California. We had completed our normal exercises and were heading for our home port. Suddenly a signal came directing us to form a scouting line and head in a westerly direction at high speed. No other information was given, but it was obvious that this was no drill. Human life was involved! For the next half hour, until the delayed dispatch came through saying that it was a downed airplane, we could get no further information. I remember well the sulphurous language used on the bridge of my ship.

The general idea was, "How good a search can they expect us to make if we don't know what's happened or what we are searching for?"

I feel that the post-Second World War state of mind of the people in the United States, in the matter of atomic energy, resembles our state of mind in that search off San Diego before we knew what we were searching for.

I believe there is a tendency on the part of people who have only superficial knowledge of Washington to think that the experts there know all the answers, even about highly complicated subjects. It is true that learned speeches and documents are produced in Washington, but most of these result from careful search through records of human experience and meditation which date back to the Renaissance or at least the middle nineteenth century.

Nuclear physics and its Frankenstein creation, atomic energy, are in an entirely different category. From the turn of the century until 1945 no one except the high priests of science had thought deeply on the subject. Since 1945 there has been a great deal of thinking and writing by articulate people on the atomic age but, in most cases, the authors were as ill at ease on the subject as a Victorian-concert audience suddenly subjected to modern jazz. The result, in too many cases, has been primarily a reflection of the worries of the author set off with bits and pieces of information taken uncritically, and on faith, from scientists or their writings.

The great importance of atomic energy makes it crucial that we absorb elementary nuclear science into our folklore as soon as possible. Only by doing this will we obtain seasoned and mature reactions to the subject. To the large majority who now regard atomic energy as black magic, this might seem like saying that high-school sophomores are in immediate danger unless they master the Einstein theory. In my opinion, this is far from the truth. The basic facts of nuclear physics are simpler and easier to learn than inorganic chemistry. There is certainly no reason for delay and

every reason to accelerate the unemotional teaching of this simple and highly important body of facts and relationships to every high-school child and intelligent adult. This teaching should not be complicated and confused by injecting emotional dialectics and "either or" conclusions. As in the destroyer search — let the "lookouts" have the facts, and trust to their good eyes and brains to find fresh answers.

William Sterling Parsons, Read Admiral, U.S.N., is Director of Atomic Energy in the Office of the Chief of Naval Operations, Department of the Navy, and Deputy Chief, Armed Forces Special-Weapons Project. From 1943 to 1945 Admiral Parsons was assigned to the Manhattan Engineer District, U.S. Engineer Project "Y," Santa Fe, New Mexico. He was weaponeer and bomb commander in the plane which dropped the first atomic bomb on Hiroshima. Admiral Parsons served at Operation Crossroads (Bikini) in 1946 and was Deputy Commander of Operation Sandstone (Eniwetok) in 1947-1948.

III. Morse Salisbury

David E. Lilienthal has said, "Atomic energy is your business," and he added, in substance, that the good management of this business depends upon an enlightened citizenry, aware of its tremendous responsibilities. He has said, and most of us agree and believe, that we must learn to understand the atom.

Atomic energy, the greatest of all material forces, is here for *good* — or for destruction. The choice actually is ours: the choice of a well-informed people, who have learned to know the atom's implications. We need not be physicists, chemists, or nuclear scientists. To understand the significance of the gasoline engine, and to drive a car safely and properly, we need not be garage mechanics. We need but recognize the vehicle's potentials. Just so, we need to recognize the potentials of the atom.

Atomic energy is *not* new. Atomic energy is as old as the sun. In fact, it is the basic force and energy of the universe. But it may seem new to us, and it may seem beyond our

comprehension, because we are unable to relate the phenomena of nuclear fission to any comparable human experience. We do need, therefore, to learn and understand the basic facts of atomic energy; such elementary and simple facts as will allow us to appreciate the nature of the process of producing the fissionable materials which can be used either in weapons or for the production of useful power. Through such a fundamental understanding, the necessity for international controls of a specific nature will become more evident to us.

Atomic energy here in America is a responsibility of the people as a whole. The Atomic Energy Act of 1946 provides for a virtual government monopoly over the handling of fissionable materials. We need to know, each of us, why the people's representatives in the Congress determined that such a course of action was to the best interests of us and of mankind. When we have learned that, we will be better able to play our part in making future decisions on the issues of control and use of atomic energy. We will be in less danger of losing our heritage by default.

Numerous predictions of the blessings of an atomic age have been made. How realistic are these predictions? Once we learn about the atom, we had better judge what benefits to mankind can be within our grasp. We see the atom already at work in medicine and in agriculture; we see its possibilities in industry. Atomic energy is more, much more, than just another problem: it is a major problem of our age. Decisions of great moment will be required. Either the people will make them, or the decisions will be made for them. Either the people will learn the facts or they will take orders. Educators can influence the choice.

Morse Salisbury is Director of Public and Technical Information for the United States Atomic Energy Commission. He is the former Assistant Secretary-General of the International Emergency Food Council and former Director of Information for the United States Department of Agriculture.

COMMUNICATIONS MEDIUMS EXPLAIN AND ILLUSTRATE NUCLEAR ENERGY

I. Magazines and Nuclear-Energy Education

Volta Torrey

The word "atom" seldom appeared in American newspapers or magazines during the Second World War. Few readers missed it, but the voluntary censorship which kept it out of the press left a big gap in the minds of both editors and readers. Their plight, when the use of the bomb thrust the word into the headlines, was like that of a young public-relations officer who had been assigned to the Manhattan Project several months previous. While being interviewed and investigated, he was not told anything about the project. Finally, a senior officer took him aside and confided to him, "We've split the atom."

"That's too bad," the young man replied sympathetically.

Most of the writers, artists, and editors who produce the mediums of mass communications were equally unfamiliar with nuclear physics when the bomb burst. The physicists who could have helped them in those hectic first few days were loathe to do so; they were not sure yet what should and what should not be disclosed. The journalists did the best they could under these handicaps, but the results were often unfortunate. The bomb's importance was exaggerated in some articles and grossly underestimated in others. Similar misconceptions were implanted in people's minds about other applications of nuclear energy, and about the gravity of the political problems that the chain reaction in the bomb had created.

Those days, fortunately, are over now. The physicists have become missionaries for science. Appalled by the miracle which their theories wrought, they have invited the journalists into their laboratories more enthusiastically than ever before and have turned to them for help in ex-

plaining their creed and their work. Whereas Newton, Davy, and Faraday reported their achievements only to the Royal Society, their successors have spoken directly to the representatives of the press. And to help the fourth estate translate technical matters into the language of the layman accurately, Nobel prize winners have made themselves nearly as accessible as politicians.

The custody of the bomb, moreover, has been entrusted to men who realize that the nation's security could be jeopardized by public ignorance as well as by espionage. The Atomic Energy Commission has striven to co-operate with responsible writers and artists as much as conditions and legal restrictions permit. You will not find detailed descriptions for making and detonating an atomic bomb in the newspapers or magazines, but you will find a lot of information that will help you cope with the atomic problem as a citizen.

This information is not always on the front pages of the newspapers. The necessity for speed, the limitations of space, and the competition of other events often handicap the reporter of spot news. When covering a Supreme Court decision, he may safely assume that his readers have heard of the Constitution of the United States and know some of its provisions. When covering news of nuclear physics, a deadline may force him to make the comparable assumption that his readers are familiar with protons, neutrons, isotopes, etc., even though he knows that this is a dangerous assumption.

The feature writers and magazine writers are more fortunate. They are more likely to have time enough and space enough in which to include the bits and pieces of old information which make the significance of their new information clear to their readers. Whereas the newspaperman, quite properly, may gloss over details about which he is uncertain, the magazine writer may go back and make sure about them. Time also permits the magazine man to organize his

material more carefully, in ways which are less liable to confuse or mislead the casual reader.

These facts of journalism should be recognized by everyone interested in public education. The best material is not always in the latest bulletins from the press-association wires. It is more likely, in fact, to be found in the articles and illustrations which are prepared a bit more slowly for later editions of the newspapers, or for publication in the weekly or monthly magazines. It may even be found in the guise of a comic strip.

The Reader's Guide to Periodical Literature lists a great many articles about atomic energy. They are not all 100 per cent accurate; there are quacks among journalists as well as among doctors. But most of the publications listed in such an index are edited by conscientious men, who sincerely believe that the truth is more fascinating and easier to merchandise than fiction. They think of their periodicals as channels of communication between the specialists and the public and are constantly striving to improve them. They have rectified many of the mistakes of the past and are now popularizing knowledge of science more honestly and accurately than ever before.

Necessity has forced the writers and editors of magazines having large circulations to perfect techniques which attract and hold the interest of many people. They cannot "flunk" anyone, as a teacher might, for not paying attention. They must make their subject matter enticing or perish. That these techniques are applicable to scientific matters is shown every month by magazines such as *Popular Science*. The circulations of magazines of this type have risen remarkably, and part of the explanation may be that the front-page news becomes both clearer and more interesting when read with the background of information that these magazines supply.

At its best, journalism may accomplish even more than formal schooling. An example was John Hersey's report on

Hiroshima, to which *The New Yorker* devoted a whole issue. That account of what happened to human beings when the bomb exploded told a great many people more about nuclear fission than they had been able to learn, or could ever have learned, from the finest physics textbooks.

Volta Torrey is managing editor of *Popular Science Monthly.* A former newspaper reporter, he was a Nieman Fellow at Harvard University.

II. Radio and Atomic-Energy Education

Irving J. Gitlin

Radio's role in the transmission of attitudes and information on atomic energy is particularly difficult to assess. Not only is it practically impossible to isolate the effect of radio on the mass consciousness, but the medium itself is complicated and varied, with few scientific studies to validate the impressions of the radio educator. These complexities are indicated by the many types of programs that have been devoted to nuclear energy. Every level of radio production has been utilized: news broadcasts, commentaries, discussion programs, interviews, dramatic programs, full-scale documentaries. Pooled network facilities brought listeners eyewitness accounts of the Bikini atom-bomb tests. Other important broadcasts included John Hersey's notable "Hiroshima," narrated in its original form in four half-hour programs over the A.B.C. network; a full-hour documentary entitled "The Sunny Side of the Atom" emphasizing the peacetime applications of atomic energy and presented by C.B.S.; a twenty-program series of talks entitled "You and the Atom" by C.B.S.; a thirteen-week series of dramatic programs entitled "One World or None" broadcast by local New York City station WMCA, and sponsored by a group of scientists headed by Albert Einstein, J. Robert Oppenheimer, and Harold C. Urey; and most recently the Mutual network's four-program series utilizing different popular formats: drama, murder mystery, and audience-participation quiz.

The total number of programs on atomic energy unquestionably runs into the hundreds, and the mass effect has certainly been to acquaint the public with at least the basic terms and ideas of atomic energy. But the development and changes of opinion and attitudes brought about by these programs have hardly been studied. Fortunately there are some exceptions to this general lack of information. One is a report of a subcommittee of the Social Science Research Council entitled "Public Reaction to the Atomic Bomb and World Affairs." [1] Part of this nationwide polling survey of attitudes and information was devoted to the source of ideas about the atom bomb. The majority polled indicated that they had obtained most of their information about the bomb from radio and newspapers, with each of these mediums mentioned with about equal frequency. About 8 out of 10 had heard about the bomb on the radio. Radio was found to have reached more of those in the lowest income and educational levels than newspapers, and as many in the higher levels as newspapers. More people regarded radio as their most trustworthy source of information about the bomb than so regarded newspapers, and the reasons given most often for this were that "it is more reliable" and "gets the news quickly."

The second noteworthy investigation is a recent study by the C.B.S. research department on the effectiveness of the full-hour-documentary program, "The Sunny Side of the Atom." This study, conducted by the Program Analysis Division under the supervision of Tore Hallonquist, attempted to evaluate the broadcast in terms of its impact on attitudes and its educational effect. The program-analyzer technique of audience-reaction study was utilized. This system is described fully elsewhere,[2] but briefly it consists of a

[1] Public Reaction to the Atomic Bomb and World Affairs, Report of the Social Science Research Council Subcommittee on Public Reactions to the Atomic Bomb and International Relations (Ithaca, N.Y.: Cornell University, April 1947).

[2] T. Hallonquist and E. A. Suchman, "Listening to the Listener," in *Radio*

continuous polygraph record of the individual responses to an electrical transcription played for a sample-listener group. Each subject registers his second-by-second approval or disapproval by pressing a green or red pushbutton assigned to him. Indifference is registered by not pushing either button. This mechanical record is backed up by questionnaires which determine attitudes before and after the playing of the program, and interviews by a psychologist.

So far as attitudes were concerned, "The Sunny Side of the Atom" attempted to do three things: (1) stimulate listener interest in atomic energy and counter the "closed-mind" attitude resulting from the "scare" approach to atomic education;[3] (2) inform listeners of the constructive peacetime applications of atomic energy; (3) make listeners less fearful of atomic energy. The results showed that the program had in large measure achieved its aims. The program's effectiveness in stimulating listener interest in atomic energy was limited because interest was high even prior to the show. But the *reasons* for the group's interest switched from such factors as "educational subject" and "vital subject" to "future benefits" and "stimulated by broadcast." Not a single listener gave "fear" as his reason for interest or lack of interest after the broadcast. The program was successful in making more listeners associate atomic energy with its peacetime effects, with an additional 20 per cent of the group now tending to relate "atomic energy" to constructive applications. The over-all emotional effect was to lessen fear of atomic energy, with 46 per cent of the group less fearful than before the sample broadcast, 3 per cent more fearful, and 51 per cent with fears unchanged. One listener exclaimed with obvious relief: "I like the way it was told. All I have heard about atomic energy before has been so fright-

Research (1942-1943), edited by P. F. Lazarsfeld and F. N. Stanton (New York: Duell, Sloan and Pierce, 1944), pp. 265-334.

[3] L. W. Kay and I. J. Gitlin, "A Problem in the Development of Opinion and Morale: Atomic Bombs or Atomic Energy?" *Journal of Social Psychology*, XXIX, No. 1 (1949).

ening." In its educational effect, one third of the listeners grasped the actual technical material, but nearly all felt they had learned something new. The object of the program was understood by most, and the over-all response in terms of liking the program was extremely good.

The general conclusions that can be drawn from this study are clear: a radio program, properly conceived and executed, can have a significant effect in allaying fears and shaping the attitudes of its listeners. The imparting of specific information appears to be less successful, but this is understandable when considered in relation to listening habits of radio audiences and the limitations of auditory transmission of information. Information pure and simple can be and is transmitted via radio, but radio as a mass educational medium would appear to have its greatest usefulness if it attempts to operate in the spheres where it is most effective: the spheres of attitudes and "living situations" rather than pure facts. Successful educational radio programs, regardless of their format, must be based on an understanding of the requirements of the medium so far as the audience is concerned. These include such technical factors as relation to everyday problems, personal involvement, unity, and the stress on human interest material.[4]

More important, however, than any conclusions that can be drawn today is the obvious need for more studies of a fundamental nature on the principles and dynamics of opinion and attitude formation for all the mass-communication mediums, including radio. It is here that the radio educator looks to university research organizations to take the lead. A vigorous research program aimed at establishing a valid body of theory on mass communications is a crying need of the present.

[4] O. Katz and P. Eisenberg, "Showmanship in Radio Educational Programs," *The Journal of Psychology*, XX (1945), 135-45.

Irving J. Gitlin is science specialist on the staff of the Department of Public Affairs of the Columbia Broadcasting System and is a member of the network's Documentary Unit.

III. "Splitting the Atom" — Starring Dagwood and Blondie

How It Developed

Louis M. Heil and Joe Musial

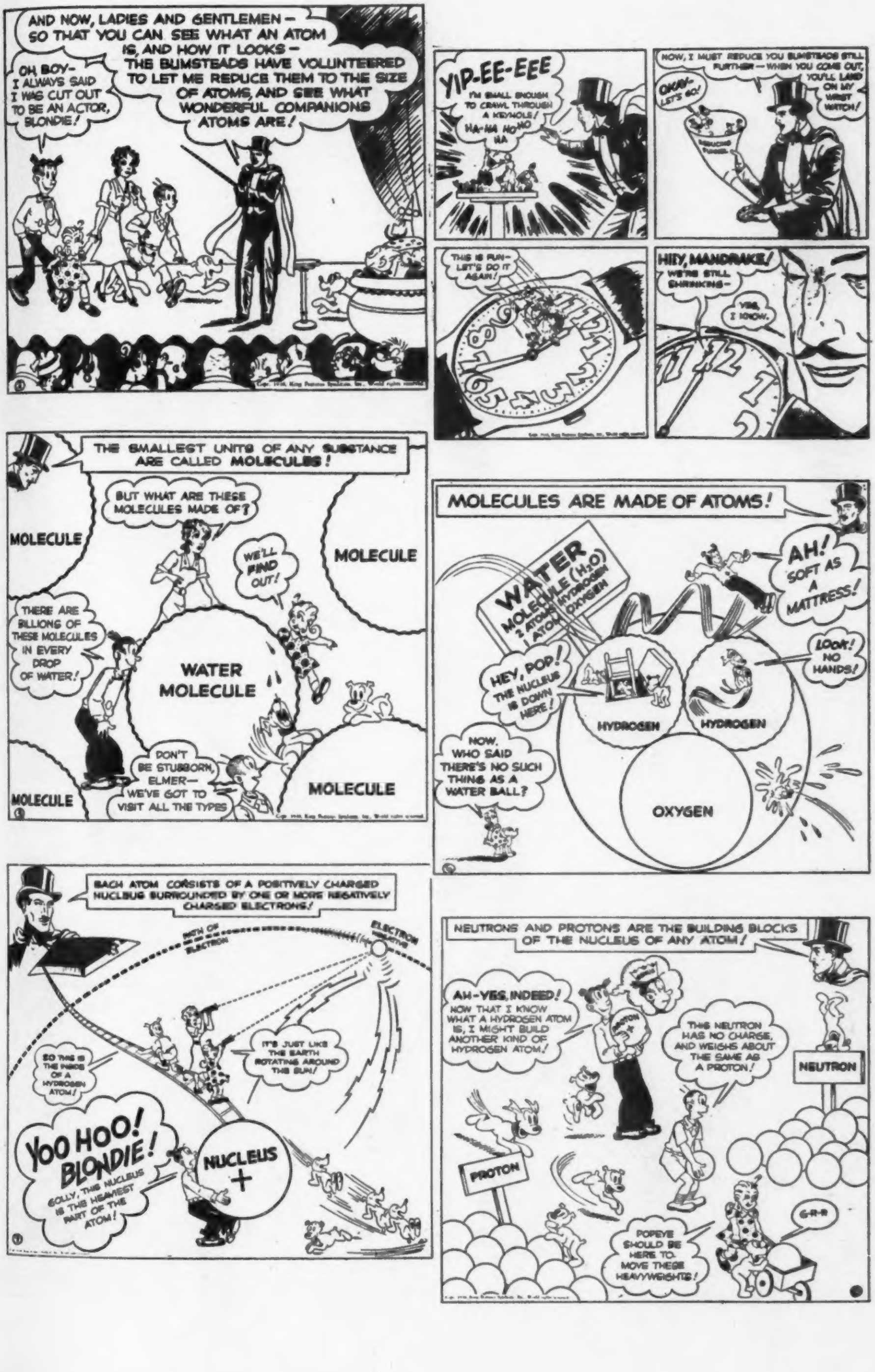
During the first two meetings of the over-all Committee on Atomic Energy of the Golden Anniversary Jubilee Committee, Lt. Gen. Leslie Groves (ret.) suggested that the basic concepts of atomic energy might be developed by a cartoon sequence. Because of General Groves's fondness for Dagwood and Blondie, he also suggested that these characters be considered as playing the principal roles.

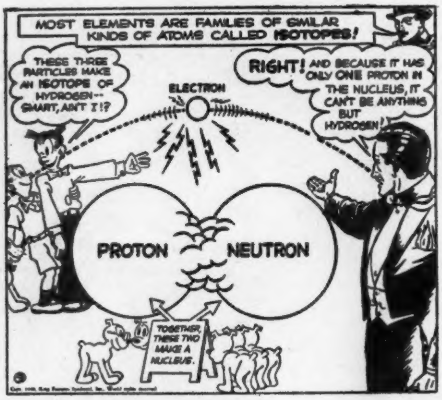
In a planning meeting, by a subcommittee on the basic-science aspect of the Atomic Energy Exhibit, General Groves's suggestions were considered and steps were taken to evolve such a sequence. It became necessary, of course, to decide on certain principles regarding how such a comic strip should be developed. One of the major principles agreed upon was that the comic characters should participate in the exploration of the atom and that the characters should not be used to exemplify any part of the atom themselves.

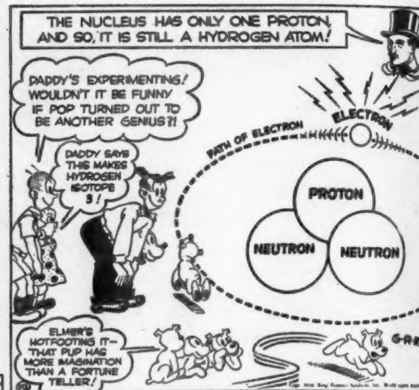
In the early meetings of the basic-science subcommittee, suggestions also were made concerning specific pictures to appear in the sequence. These suggestions had to do with a "trap door" in the outer part of an atom, ways of reducing Dagwood and Blondie to atomic size, and how the hardness and compactness of the nucleus could be illustrated. A difference of opinion existed, however, concerning the way in which the specific pictures should be developed. Many of these differences were due, as was revealed later, to a lack of knowledge concerning how to present ideas in comic form. At this point, therefore, the services of an expert on comics had to be obtained.

The next step involved the actual preparation of rough sketches. Mr. Joe Musial, head of the comic-book department of King Features and Dr. Louis M. Heil, head of the physics department of the Cooper Union, New York, served as a work team to evolve the first rough sketches. This work revealed that many of the original ideas of the committee had to be modified. It also showed that the artist had to learn a good many of the basic facts concerning atomic energy and that the physicist had to learn a good many things about how ideas are expressed through the comic-character medium. One example of how the ideas of the committee had to be modified occurred in the part of the series which was devoted to reducing Dagwood and Blondie to atomic size. The committee had the idea that this could be shown by first making them as small as a finger, then comparable in size to a hair on the finger, and then finally reducing them to the size of the atom. This procedure turned out to be unworkable, and the alternative, as shown in the strip, had to be employed, primarily because of the familiarity of people with such things as watches and the unfamiliarity of the hair on the hand. Another major problem in the development of the series had to do with transitions from one picture to another. For example, in setting the stage for a splitting of the atom by Dagwood with a "neutron bazooka" it was found desirable to have one of the pups say "what they need is advice." Throughout the sequence it was found that General Groves's idea of Dagwood was a good one because Dagwood is a real "fall guy."

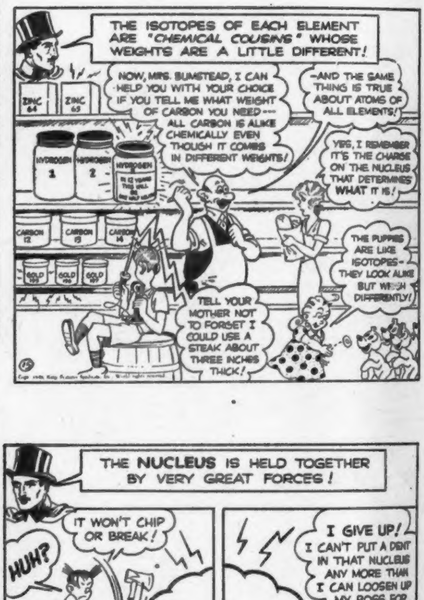
It became obvious during the development of the strip that the characters should not generally state the fundamental physical principles because such statements appear to be out of place psychologically. A search was made of the available comic characters to find one which seemed to have a scientific flavor. This was the reason for the selection of Mandrake.

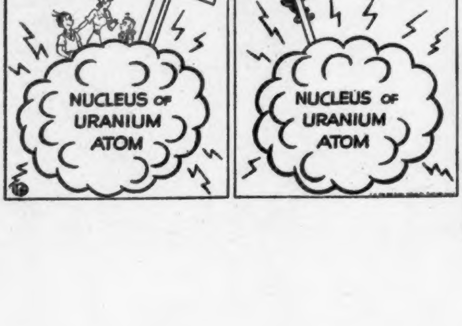

AND NOW, LADIES AND GENTLEMEN— SO THAT YOU CAN SEE WHAT AN ATOM IS, AND HOW IT LOOKS— THE BUMSTEADS HAVE VOLUNTEERED TO LET ME REDUCE THEM TO THE SIZE OF ATOMS, AND SEE WHAT WONDERFUL COMPANIONS ATOMS ARE!
OH BOY— I ALWAYS SAID I WAS CUT OUT TO BE AN ACTOR, BLONDIE!
YIP-EE-EEE
I'M SMALL ENOUGH TO CRAWL THROUGH A KEYHOLE!
HA-HA HO HO HA
NOW, I MUST REDUCE YOU BUMSTEADS STILL FURTHER — WHEN YOU COME OUT, YOU'LL LAND ON MY WRIST WATCH!
OKAY— LET'S GO!
THIS IS FUN— LET'S DO IT AGAIN!
HEY, MANDRAKE! WE'RE STILL SHRINKING—
YES, I KNOW.
THE SMALLEST UNITS OF ANY SUBSTANCE ARE CALLED MOLECULES!
BUT WHAT ARE THESE MOLECULES MADE OF?
WE'LL FIND OUT!
THERE ARE BILLIONS OF THESE MOLECULES IN EVERY DROP OF WATER!
MOLECULE
MOLECULE
WATER MOLECULE
MOLECULE
MOLECULE
DON'T BE STUBBORN, ELMER— WE'VE GOT TO VISIT ALL THE TYPES
MOLECULES ARE MADE OF ATOMS!
WATER MOLECULE (H_2O) 2 ATOMS HYDROGEN 1 ATOM OXYGEN
AH! SOFT AS A MATTRESS!
HEY, POP! THE NUCLEUS IS DOWN HERE!
LOOK! NO HANDS!
HYDROGEN
HYDROGEN
NOW, WHO SAID THERE'S NO SUCH THING AS A WATER BALL?
OXYGEN
EACH ATOM CONSISTS OF A POSITIVELY CHARGED NUCLEUS SURROUNDED BY ONE OR MORE NEGATIVELY CHARGED ELECTRONS!
PATH OF ELECTRON
ELECTRON NEGATIVE
IT'S JUST LIKE THE EARTH ROTATING AROUND THE SUN!
SO THIS IS THE INSIDE OF A HYDROGEN ATOM!
YOO HOO! BLONDIE!
GOLLY, THIS NUCLEUS IS THE HEAVIEST PART OF THE ATOM!
NUCLEUS +
NEUTRONS AND PROTONS ARE THE BUILDING BLOCKS OF THE NUCLEUS OF ANY ATOM!
AH-YES, INDEED! NOW THAT I KNOW WHAT A HYDROGEN ATOM IS, I MIGHT BUILD ANOTHER KIND OF HYDROGEN ATOM!
THIS NEUTRON HAS NO CHARGE, AND WEIGHS ABOUT THE SAME AS A PROTON!
NEUTRON
PROTON
POPEYE SHOULD BE HERE TO MOVE THESE HEAVYWEIGHTS!
G-R-R


MOST ELEMENTS ARE FAMILIES OF SIMILAR KINDS OF ATOMS CALLED ISOTOPES!
THESE THREE PARTICLES MAKE AN ISOTOPE OF HYDROGEN-- SMART, AIN'T I!?
RIGHT! AND BECAUSE IT HAS ONLY ONE PROTON IN THE NUCLEUS, IT CAN'T BE ANYTHING BUT HYDROGEN!
ELECTRON
PROTON
NEUTRON
TOGETHER, THESE TWO MAKE A NUCLEUS.


THE NUCLEUS HAS ONLY ONE PROTON, AND SO, IT IS STILL A HYDROGEN ATOM!
DADDY'S EXPERIMENTING! WOULDN'T IT BE FUNNY IF POP TURNED OUT TO BE ANOTHER GENIUS?!
DADDY SAYS THIS MAKES HYDROGEN ISOTOPE 3!
PATH OF ELECTRON
ELECTRON
PROTON
NEUTRON
NEUTRON
ELMER'S HOTFOOTING IT-- THAT PUP HAS MORE IMAGINATION THAN A FORTUNE TELLER!


ALL ATOMS ARE MADE OF PROTONS, NEUTRONS & ELECTRONS!
IF I PUT THE RIGHT NUMBER OF NEUTRONS, PROTONS AND ELECTRONS TOGETHER, I'LL HAVE CARBON-- DIAMONDS ARE A FORM OF CARBON- H'M'M!
OH, WHY DO I WASTE MY TIME IN AN OFFICE, WHEN, IF I CAN PUT THESE THREE KINDS OF BUILDING BLOCKS TOGETHER IN THE RIGHT COMBINATION, I CAN MAKE GOLD!- WHY, I'D BE IN THE DOUGH-- A MILLIONAIRE!- ---I MEAN, A BILLIONAIRE! OH, BLONDIE!
NEUTRONS
?
GOLLY- I'M GOING TO TRY TO BUILD SOME OF THAT URANIUM STUFF WE HEAR SO MUCH ABOUT!
ELECTRONS
PROTONS


THE ISOTOPES OF EACH ELEMENT ARE "CHEMICAL COUSINS" WHOSE WEIGHTS ARE A LITTLE DIFFERENT!
NOW, MRS. BUMSTEAD, I CAN HELP YOU WITH YOUR CHOICE IF YOU TELL ME WHAT WEIGHT OF CARBON YOU NEED--- ALL CARBON IS ALIKE CHEMICALLY EVEN THOUGH IT COMES IN DIFFERENT WEIGHTS!
-AND THE SAME THING IS TRUE ABOUT ATOMS OF ALL ELEMENTS!
YES, I REMEMBER IT'S THE CHARGE ON THE NUCLEUS THAT DETERMINES WHAT IT IS!
ZINC 64
ZINC 65
HYDROGEN 1
HYDROGEN 2
HYDROGEN
CARBON 12
CARBON 13
CARBON 14
THE PUPPIES ARE LIKE ISOTOPES- THEY LOOK ALIKE BUT WEIGH DIFFERENTLY!
TELL YOUR MOTHER NOT TO FORGET I COULD USE A STEAK ABOUT THREE INCHES THICK!


THESE ATOMS OF URANIUM ARE FIRST COUSINS, AND THE ONLY DIFFERENCE IS THAT ONE HAS THREE MORE NEUTRONS THAN THE OTHER!
THESE ARE CALLED ISOTOPES OF URANIUM BECAUSE THEY HAVE THE SAME NUMBER OF PROTONS!
URANIUM 238 92 PROTONS 146 NEUTRONS 238
NUCLEUS OF URANIUM ATOM
URANIUM 235 92 PROTONS 143 NEUTRONS 235
I'M GOING DOWN AND FIND OUT WHAT THIS 235 IS ALL ABOUT!
NUCLEUS OF URANIUM ATOM


THE NUCLEUS IS HELD TOGETHER BY VERY GREAT FORCES!
HUH?
IT WON'T CHIP OR BREAK!
NUCLEUS OF ATOM
I GIVE UP! I CAN'T PUT A DENT IN THAT NUCLEUS ANY MORE THAN I CAN LOOSEN UP MY BOSS FOR A RAISE- I'LL GET SOME HELP!
235


GR-R-R-
NOT EVEN A SCRATCH!
WE'VE BEEN TRYIN' TO SPLIT THAT THING FOR HOURS!
YEAH! LET'S EAT!
I QUIT!
LET'S GIVE UP, DAGWOOD! WIT'OUT ME SPINACH I AIN'T GOT ME STRENSK!
OH, WHY DO I LET MYSELF IN FOR THINGS LIKE THIS?
TELL IT TO THE MARINES, POPEYE!
NUCLEUS OF URANIUM ATOM 235
OOOO
WHAT THEY NEED IS--- ---ADVICE
UNCHARGED NEUTRONS ARE THE MAGIC BULLETS WHICH CAN SPLIT THE URANIUM 235 NUCLEUS EASILY!
TRY THIS NEUTRON BAZOOKA-IN IT I'VE PLACED A SINGLE NEUTRON-AND IF YOU BLOW JUST RIGHT I THINK YOU CAN SPLIT THAT URANIUM ATOM!
CYCLOTRON MFG CO.
NEUTRON
NOW HE TELLS ME!
NUCLEUS OF URANIUM ATOM 235
BLONDIE
OH, BOY---
I DID IT!
I GOT TH' TOUCH -IT'S SPLITTING!
NUCLEUS OF URANIUM ATOM 235
YIPE
U 235 ATOM SPLITS! TWO LARGE RADIOACTIVE ATOMIC FRAGMENTS FLY APART VIOLENTLY! —SEVERAL NEUTRON BULLETS SHOOT OUT! MILLIONS OF ELECTRON VOLTS OF ENERGY ARE RELEASED!
CAN YOU TIE THAT? I MADE A HIT WITH ONE NEUTRON, AND AFTER IT SPLIT, THERE ARE NOW THREE OF 'EM!
SMACK
NEUTRON
NEUTRON
NEUTRON
NEXT!
PHOOEY!
NEUTRON BULLETS SHOOTING OUT OF THE SPLITTING OF A SINGLE URANIUM ATOM CONTINUE ON, VIOLENTLY SMASHING OTHER URANIUM ATOMS! MORE NEUTRONS!! MILLIONS OF ATOMS SPLIT!!! STILL MORE NEUTRONS!!! TRILLIONS OF SPLITS!! THIS IS THE CHAIN REACTION!
NOTHING DOING-YOU CAN WATCH THIS CHAIN REACTION FROM OUT FRONT WHERE THE PEOPLE ARE!
THIS ACTION MULTIPLIED TRILLIONS OF TIMES IS THE ATOMIC BOMB!!
AGRICULTURE
INDUSTRY
MEDICINE
TRANSPORTATION
POWER
BANG
BLONDIE
THAT WAS AN AWFUL BIG NOISE, EH, DAGWOOD? IT TOOK POWER TO MAKE THAT NOISE--ALL WASTED! NOW THE JOB IS TO FIND HOW THAT POWER CAN BE USED, NOT WASTED--

The rough sketches as developed by Musial and Heil were reviewed by the committee as a whole and minor changes made prior to the translation of the working drawings into the large 4′ x 4′ panels in color which were installed as a part of the exhibit.

The comic strips are reproduced by permission of King Features Syndicate and *Puck, The Comic Weekly*.

Louis M. Heil is Professor of Physics at the Cooper Union, New York. He was an expert consultant to the War Department on the selection of civilian scientists. Professor Heil has taught at the University of Chicago, Ohio State University, the Ohio University at Athens, and was a General Education Board Fellow in 1936.

Joe Musial is Director of Comic Books and of the Education Division of King Features Syndicate.

WHAT IT MEANS TO ME TO BE GROWING UP WITH NUCLEAR ENERGY

I. Yoshio D. Kishi

The importance of the atomic age is easily comprehensible, ushered in as it was, abruptly and importunately by the necessity for ending war. I realize, too, what this atomic age will mean to me as a member of a generation which will have to grow up and live with the delicate knowledge of both the atomic bomb and the more beneficial atomic sciences.

In my time, most probably, there will be extensive advances in the pure sciences, advances perhaps more remarkable and astounding than those which led to the development of the bomb itself.

The advances which will be made may not create a Utopia for us but I feel certain that there will be remarkable changes in the structure of living in this world. Scientists have been able to apply what knowledge they have now to the solving of many problems and to finding the key to others. In time, this work itself will be amplified many, many times.

To me, personally, the atomic age will not mean so much in terms of discoveries in biology, medicine, chemistry,

physics, and engineering as in terms of the actual implications of the atomic bomb and its influence upon our society.

Before any discoveries can be utilized for general benefit, the world will have to learn to live in peace. The knowledge garnered from research on the atomic bomb is not important in itself. The world has always had knowledge. It is especially important because it vividly magnifies the need of people to learn to live together. Never before has the world been confronted by an instrument of such potentialities for wholesale destruction — an instrument about which we all know so little. With such a potent weapon existing among us, it is necessary to develop bonds strong enough to hold us together.

The atomic age will be a time for society to catch up with science. People all over the world will have to be educated and taught the meaning and the importance of the atomic bomb and the atomic sciences; the meaning and importance of such knowing in relation to their influence on culture. It is the knowing of science in relation to our society which is to be valued, rather than the knowing itself.

Advances in science must be understood by everyone or these advances will only be statistics. People will not realize or understand what to do with these uncorrelated facts. When this occurs, ignorance will foment fear and fear will arouse mistrust. Mistrust, in turn, is an ideal cauldron in which to brew war.

Without education, life would be like having a book when one could not read. It is for us, then, to see that all learn how to read.

The atomic bomb and the atomic age have succeeded in making me more aware of the importance of world co-operation and the necessity to be informed. They have illuminated sharply the necessity for myself and for others to be aware of this need.

Yoshio D. Kishi is a senior at the Bronx High School of Science in New York City. He is on the staff of the school literary magazine.

II. Barbara Schiff

It has been during my lifetime, the past sixteen years, that the greatest advances and discoveries in the field of nuclear energy have taken place. And now I am among those faced with the prospect of living in the age of nuclear energy.

Today, I am standing at the entrance of this era and see some of the visions that atomic energy presents — great strides in the field of medicine, new methods of production, a new form of power, better methods of agricultural development. I want to walk through this doorway and live when these things are a greater reality than they are at the present time. However, on picking up the newspaper today these hopes are not encouraged, for one reads about unsettled international conditions and the efforts of our statesmen to solve these problems. Growing up in the age of nuclear energy means that today I must be a part of that group that still has some optimism left regarding the human race and wants to see it preserved. The fact that atomic energy has been used to destroy such numbers of innocent people means that all of us must think and act more rationally than ever.

I can, perhaps, accept nuclear energy more objectively than some who are my elders, because this power was presented to the world just at the time when I was beginning to be aware of the momentous surroundings about me.

The age of nuclear energy cannot bring changes without new obligations for us all. I think that a new curriculum should be introduced to the school, starting with the grammar-school grades, to acquaint those of us who are growing up in this atomic age with the problems, benefits, and responsibilities this new force brings. Besides dealing with the scientific aspect of nuclear energy and its implications, the curriculum should include a firm foundation of history and literature, as well as a guide to human relations. If we can learn to live with one another we can face the future of the age of nuclear energy with hope and courage.

We who are growing up must be prepared to become the leaders of tomorrow. We can do our part by taking an active interest in world affairs, and by discussing them among ourselves and with our parents and teachers.

I want the opportunity to make my ambitions and dreams become realities in the better world that nuclear energy can and must bring.

Barbara Schiff is a senior at the Hunter College High School in New York City. She is president of the Physics Club.

THE ADULT MEETS AND TRIES TO UNDERSTAND THE ATOM

I. The Adult Tries to Understand the Atom

George L. Glasheen

Marengo, Iowa, is a midwestern town of 2,260 men and women. Along with the people of thousands of other communities, great and small, throughout America, the people of Marengo are interested in atomic energy, and have large stakes in the atomic age. And they are trying to do something about it; they are trying to learn and understand the atom.

Marengo's efforts are not spectacular. Rather are they fundamental and typical of what any community can undertake. They reflect, in minuscule, the efforts of all people, everywhere, to grasp the meaning of the atom. Marengo's citizens have built their atomic activities about their long-established evening school. They refer to their project as the Marengo Experiment in Atomic Energy Education.

This year, nearly 450 of Marengo's townspeople are participating in this co-operative educational project. They like to think they are developing a pattern of community action which can be used elsewhere.

What do they do? Well, of course, they attend lectures in the local-school auditorium, and they view films and demonstrations. Visiting speakers from the state university address them on the customary subjects connected with atomic energy. They examine the atom's social and economic implications. They become familiar with its physical characteristics. They learn to sift the fantastic promise from the anticipated fact. They discover that atomic energy is already at work for *good,* and, in Iowa, in agricultural, medical, and biological experimentation. But they are learning and doing other things as well.

Under the direction of a school of education faculty member from Iowa City, about 30 miles distant, the people of Marengo are making a systematic documentation of their own atomic experiences. They have questions to ask at their larger lectures and at their more intimate forums, but they always write them out and keep a record of the answers. Whenever they complete the study of a book, from their selected and recommended reading list, they prepare a written appraisal for the critical analysis of their fellow citizens, at their frequent round-table discussions. They keep a log of their study-group meetings, and thus they hope to chart their progress. They test themselves weekly on their atomic-vocabulary attainments, and they plan to submit abstracts and critiques of their total participation to their "faculty" adviser, for his review and evaluation, with authorship remaining anonymous, but for age, sex, and occupation. In this way, they hope to determine, at year's end, through such self-criticism, what they as a group, and as individuals, have learned; to discover how much better prepared they are to assume their atomic-age responsibilities. They think they may be developing a blueprint for community action, through the recorded inventory of their activities, which may prove helpful to others. They know they are learning about the atom. They are conducting an adult-education program at an adult level.

That is what the people of Marengo are doing. They are no different, however, from the people of Charlottesville, Virginia, or Portland, Oregon, who mobilized so successfully the civic forces of their respective communities — the service groups, the women's clubs, the schools, the churches, the merchants, the citizens of all trades and occupations, of all political beliefs and complexions — into programs of action on atomic energy. Through public lectures in local theaters and school halls; forum discussions; film showings; appropriate literature distribution, at such central locations as their libraries and their public meeting places; pamphlets; radio programs over local stations; articles in their daily press, etc., the people of these communities learned about atomic energy. They learned of its potentialities for good, and for destruction. They learned of their responsibilities as citizens in connection with the control and utilization of this new force. They learned because they wanted to learn; they learned the "grass-roots" way, through community cooperation and participation.

Other towns, and other cities have acted, as well. The men and women of Prince Georges County, Maryland, spearheaded to action by the local League of Women Voters; the residents of St. Louis, Missouri, geared to effectiveness through their Citizens' Committee, and the people of Stamford, Connecticut, through concentrated community action, have all succeeded in bringing the atom to Main Street. They have constructed and sponsored exhibits. They have had "big name" speakers, and "small," secured generally on a volunteer basis from colleges and universities or from industrial concerns conducting nuclear research. Their libraries, through appropriate displays and preparation of reading lists, their schools, through their physical and social-science teachers, and their various occupational groups have combined to assist all, and each other, in learning more about the atom. They are typical of people all over America;

adults everywhere trying to learn about the atom, trying to understand nuclear energy.

A letter comes to the Atomic Energy Commission: the Boise, Idaho, Rotary Club requests a speaker for a midweek luncheon; "someone may be passing through from the East Coast, en route to the great plutonium works at Hanford, Washington." A church leader in West Virginia wants someone who can explain the simple fundamentals of atomic energy in layman's language. A housewife from Texas wants information and help with regard to introducing atomic energy to her club group. And people from countless cities and towns request assistance in developing "atomic-energy weeks," in securing exhibits, in building community educational programs. These are not exceptions, they are the rule; people seeking, everywhere, trying to understand the atom, making great use of their native ingenuity and local resources in developing atomic activities.

When electricity was first discovered, the adult could sit back and say, "That's too much for me to understand, I'll leave that to the younger generation." When the airplane first became popular, the young people of school age, the adults of today, were the ones who took over. But it is not that easy with atomic energy. Time is short; we cannot wait. The adult must learn, *today!*

This means there is a big job to be done in atomic education, at the adult level. Parent-teacher groups have a great obligation and an enviable opportunity to tie adult efforts in with those of the secondary-school groups through stimulating the study of atomic energy. Service clubs can devote their weekly meetings and luncheons, with profit, to this most important subject to come before mankind. Good speakers can be secured, in most cases, from schools and colleges in the immediate vicinity, and from local scientific and educational associations. Labor groups, manufacturers associations, and women's clubs, are already leading the way;

through the preparation of readable material they can and should place atomic energy high on their program calendars. This is a job for all America, for all groups to foster. Atomic energy is here for *good,* for us all.

We need clearing houses for atomic information, citizen committees for atomic education, and speakers' bureaus. We need adult-education forums and discussion groups throughout our country. Atomic energy — atomic education — cannot be left for another generation to assimilate through the ordinary processes of educational osmosis; we cannot leave it for tomorrow!

George L. Glasheen is Assistant Director for Educational Services of the United States Atomic Energy Commission. He was formerly Executive Director of the National Committee on Atomic Information.

II. Exhibits as a Technique in Atomic Education

Michael Amrine

It has been well said that our civilization is a race between education and catastrophe. In 1948 it appears that atomic energy has given catastrophe a fearful potential lead, and that, therefore, every means of communication and education should be used in attempting to reach the greatest problem in cultural lag ever to confront mankind.

Without dwelling too much on the problems touched in other sections of this journal, it can be said that the attempt of Brookhaven National Laboratory and its parent organization, Associated Universities, Inc., to manage an exhibit program has been designed to study, in a small way, the problems of communication posed by a human development which burst upon the consciousness of the country with an overwhelming suddenness. After running an exhibit program since early 1947, our doubts concerning the exhibit technique relate chiefly to its expense, and the

relatively small number of persons reached in relation to the enormous number who need to be reached. Exhibits in atomic energy *can* be effective.

The Brookhaven program now consists of two "shows" provided to communities for locally sponsored activities in public information and education. To some extent, the laboratory also provides counsel and services to local sponsors in public relations on a local level. We furnish publicity and promotion materials, assist in finding speakers, and in drafting a community program.

We have come to several main conclusions about exhibits in this field as outlined below:

1. The basic facts of atomic energy and the basic questions relating to the basic decisions the public must make are not of themselves easily adapted to the exhibit technique.

2. There is much in the atomic development which is adapted to exhibit technique, but if you rely entirely upon these elements, what you produce is simply a "science show." A science show, as it is understood in the exhibit field, is one which excites the customer to a feeling of "gee whiz." It may attract good crowds, but it does not lead to thoughtful conclusions.

3. The basic purpose of the exhibit program of Brookhaven is to serve as a focus for community programs of information and discussion, and the community programs are worth more than the exhibit.

4. It is extremely difficult to design an atomic-energy exhibit which is satisfying in itself and purely educational in the field of atomic application and implications. Some of this is due to the present complicated status of these implications and applications; part of it is due to the limitations of the exhibit technique.

5. Questionnaires in our present large show, which has been successfully exhibited in such places as the Franklin Institute, Philadelphia, The Museum of Natural History,

New York, the Buffalo Museum of Science, Buffalo, indicate that it is very difficult to steer a proper line between becoming too technical, and therefore confusing, and becoming too simple, and thus appearing condescending and unauthoritative.

For descriptive purposes, our exhibits may be designated as the "large" show and the "small" show.

The large exhibit is devoted principally to an explanation of the structure of atoms, and how science is deriving new forces from the nucleus. By means of a sound motion picture, demonstrations, displays, models, and "live" talks by demonstrators, the large exhibit provides basic facts in an interesting, understandable way, but not without some effort on the part of the exhibit visitor.

Because it is devoted almost entirely to the scientific side of the subject, the exhibit does not attempt to provide an interpretation of facts on atomic energy which might be useful to a citizen striving to make up his mind on policy matters — the details of national management of atomic energy, and the all-important matter of international control. The community program is needed to serve these needs.

The large Brookhaven exhibit requires a show place of between 8,000 and 10,000 square feet, as well as electrical outlets and accommodations generally found only in buildings devoted to exhibit activities. Moreover, it is relatively costly to administer.

For this reason, a second exhibit was developed for showing in smaller cities and communities where virtually any hall or other show place could be utilized. Generally, the showings are for periods of about one week. It has so far been to Norwalk, Bridgeport, and Hartford, Conn., and Kingston, N.Y.

The small Brookhaven exhibit succeeds in telling an integrated story on atomic energy by means of panel displays. Three components out of thirteen consist of audience-partic-

ipation devices and demonstrations. However, the attention-getting qualities of the smaller show are considerably less than those of the large exhibit mainly because the panels consist of editorial material and illustrations, rather than more spectacular elements.

In bringing these exhibits before the public, the laboratory and Associated Universities developed plans which placed a good part of the responsibilities for community-program development in the hands of local sponsors.

Experience has proved this policy wise, particularly because exhibits alone obviously cannot be expected to carry more than a part of the information and interpretation activities required in a community. To be effective, the subject of nuclear energy should be reduced to terms of public understanding in all ways available — newspaper and radio coverage, forums and discussions, talks by recognized authorities and leaders in the community, school programs, special library services, etc. Exhibits can assist in all these phases.

For example, the large exhibit was shown under the sponsorship of Brookhaven National Laboratory in Stamford, Conn., in December 1947, when that community staged an "Atomic Energy Week," which received national attention. During the week, daily attendance at the exhibit did not exceed 600 persons, outside classes of grade-school and high-school students who attended during school hours.

Over six months of painstaking planning and advance publicity promotion in the community went into the Stamford Atomic Energy Week. As a whole, the program was extremely successful, but from the standpoint of exhibit showings, the attendance figures were so low that the costs per person seeing the exhibit were exceedingly high. But without the exhibit Stamford might never have held an "atomic week."

Showings of the large exhibit were held also in New York, Boston, Buffalo, and Philadelphia.

It must be reported that the attendance figures in none of these metropolitan centers were outstanding. With the possible exception of previews or special programs organized to introduce the exhibit, widespread public interest in the exhibit and the subject were observed to be lacking.

The showings of the small exhibit all have been successful from the standpoint of the sponsoring institutions. A special "Atomic Energy Week" in the city of Bridgeport, Conn., was highly successful in bringing the subject before organizations, service clubs, church groups, and the like.

The experience of Associated Universities, Inc., and Brookhaven National Laboratory with exhibits can be viewed as experimental.

It is not clear that the main attraction of exhibits as an educational technique have proved themselves. The hope for exhibits was that they would work directly on a primary problem of atomic education, namely, to work against the feeling of mystery and mysticism surrounding atomic energy in the public mind, and by bringing something in three-dimensional form directly to the average man, help him get a feeling of familiarity with the atomic development in terms that he could understand. It is by no means certain that exhibits actually accomplished this to any great degree with any high proportion of the persons who visited them.

Michael Amrine is head of Public Education for the Brookhaven National Laboratory, Upton, Long Island, N.Y.

III. The Atomic World and Blood Development

Audio-Visual Training Section, Training Branch, Professional Division, Bureau of Medicine and Surgery, Navy Department

The widespread devastation at Nagasaki and Hiroshima indicated that a new military weapon was at hand whose destruction superseded anything in the past. The blast covered miles of territory in which hundreds of thousands of civilians lived who were without any knowledge of the means to protect themselves from its devastation. The same might be said of the physicians living in these areas.

It is considered very important that the rank and file of our population, as well as physicians, be advised that the effects of the atomic bomb are twofold, *i.e.,* blast and fire damage and irradiation damage. Much of our primary knowledge in this field is related to the blood stream.

As part of the National Military Establishment, the Navy exhibit in Man and the Atom was planned to show the effects of nuclear radiation on human blood. The development of blood in the human being from embryo to adult life is a complicated story. For a lay audience it was considered that this process could best be visualized by the use of cartoons. It was further simplified by omitting some of the more complicated factors in blood development and those about which there was professional controversy.

The presentation of the exhibit, therefore, presented "embryo" cells as the "mother" of all cells. "Young" cells were portrayed as "infants," "adolescent" cells as the "human teen-age group," and "adult" cells as "human adults." Our message was as follows:

An "L.D.-50" dose of atomic (ionizing) radiation is one which kills 50 per cent of the individuals exposed to it in a given period of time. This exhibit is concerned with the effects of such a minimal lethal dose on human blood development. It is pointed out that under

these conditions the "mother" cells may survive, all "infant" cells are destroyed, and "adolescent" and "adult" stages of cells become very "sick." Inasmuch as all "infant" cells die, the "adolescent" and "adult-group" cells from which they arise soon disappear from the blood stream as their normal life span is comparatively short. The continuation of this process would obviously lead to the ultimate death of all blood cells in the body.

As the "infant" cells die the "mother" cells slowly begin to extrude new "infant" cells into the blood stream which are at first insufficient and also promptly die as long as sufficient "lethal" radiation effects persist in the body. When the amount of radiation effect becomes insufficient to kill the "infant" cells and retard their formation, the normal process of blood development re-establishes itself.

In the meantime, however, most of the blood cells circulating in the body being dead or rapidly dying, it is necessary to introduce new cells by means of transfusions. These transfusions do not *cure* radiation illness but simply provide the body with sufficient cells to carry on its functions until that time when lethal effects of ionizing radiation have disappeared, thereby permitting the normal blood development process to be re-established.

It follows that a tremendous source of whole blood must be made available to meet any atom-bomb emergencies. The exhibit provides an emphasis for the support of blood banks and advises the public that irradiation damage is practically a counterpart of blast damage. Ergo, let us have peace instead of war.

Despite the fact that this exhibit was designed along the simplest possible lines, it is considered that many who viewed it felt it to be out of their intellectual range. In the first place, there is comparatively little reference framework among lay people for the material presented. In the second place, the material is so complicated that extreme simplification is impossible.

However, there were some encouraging reports, particularly among the more intelligent groups who viewed the exhibit, that (a) "This makes it very clear to me," (b) "I understand it now," (c) "Aren't those rays awful; they certainly do a lot of damage to the body," (d) "It is really important to support blood banks, isn't it?" (e) "What do we do if an atom bomb falls?" (f) "Where do we go for

transfusions?" and (g) "Are there any drugs which are helpful or is transfusion our only means of help?" These and similar remarks indicated to us that the material presented had some impact and results. It would seem that the man in the street with no more than a grade-school education could hardly be expected to grasp the significance of the presentation. It is very much like trying to describe in words Beethoven's *Fifth Symphony* for a reader without any musical background.

It is our opinion, however, that *no one* lost the significance of the atom bomb as a threat to civilization and health.

IV. Power from the Atom

Richard C. Robin

To present "Power from the Atom" in exhibit form, for general public consumption, the General Electric scientists and engineers determined that simple understandable facts must be shown. If we undertook to give all the historical background, basic physics, story of conversion of energy, and the handling of radioactive materials in one exhibit, we would have required an extremely large space and probably would have greatly overlapped the efforts of others. Since our primary purpose in nucleonics is to devise a way of harnessing, for useful purposes, the energy given off by the splitting of the atom, we considered that our main panel should show all the major steps in such a possible process. It was necessary to show that part of the process is still in the developmental stage and that actual production of useful power even experimentally was still a few years off in the future.

To produce fuel for bombs and atomic-power plants, facilities such as the Hanford plant in the state of Washington are required. Here the heat given up is dissipated in the Columbia River, no attempt being made to conserve it; the

production of plutonium is the primary purpose of the reactors at this plant.

To conserve heat given off by a reactor an entirely different design is required. A detailed explanation to show how such a nuclear reactor operates would be educational, but security, as defined by the United States Atomic Energy Act, prevented our making this disclosure. Also such presentation is highly technical and probably too complicated for the average audience. The problem for this atomic energy exhibit, then, became one of staying within the bounds of security and of being factual.

Three different mediums were used to present the complete story of "Power from the Atom." They overlapped in some respects but this was intentional, for each had to be an entity complete within itself. These three were the "comic" book, the flow chart, and the mechanical manipulator.

The "comic" book was a mode of presentation which we believed best suited to give a background story including history, physics, and technical problems. It quickly tells us that studies to achieve a goal have been under way for more than 2,000 years although the goal was not known. It explains what we believe an atom looks like and some relative comparison of its size — "36 billion on a pinhead." It tells how the atom is split and what chain reaction is and how plutonium is made in a reactor, and about the operating precaution in handling radioactive materials. It also explains that we expect to get useful power from the reactor under construction at the Knolls Atomic Power Laboratory in Schenectady. Ed, our 14-year-old Johnny's guide through the book, dispels Johnny's query on "those other things": "atomic flying machines on my back" — "atomic rockets to the moon" — "atomic pills to run our autos for years," by saying "Hold on, Johnny, you've been reading too many comics."

It is interesting to note that throughout this book the awestruck spectators are for the most part fully grown men and

women. The comic book is mainly directed toward the young high-school students, but it attracts the adult's attention more than any other of a long series of presentations. At the New York show approximately 250,000 of these books were handed out. To date over 1,000,000 copies have been distributed at nucleonics exhibits and schools. More millions are ready for public consumption.

The flow chart, except for the racing lights, held the adult's attention more than the child's. This was expected, for the adult is continually asking the question, "Of what benefit is this to me?" While we traced the flow of uranium from the mine, to the smelter, refinery, and to the Hanford Works for plutonium production, we also showed that plutonium and other fissionable materials can be used in a reactor to generate heat the same as in a boiler. That heat generates steam to drive our present-day steam turbine-generators for the production of electricity. We then showed that electricity can be carried over existing transmission lines to faraway cities where it can be used in agriculture, homes, industries, business, communications, and to power electric locomotives. We also stated that "ships may in time carry their own atomic-power plants."

To handle radioactive materials in our atomic-energy installations, we devised a mechanical manipulator which can be operated remotely by a shielded operator. The connection between the operator and the "hands" may be mechanical as in the instrument shown or it can be operated by use of television and an elaborated series of electrical controls. Any operation which can be performed by human hands can be performed by this device — not as deftly and with the speed of the human hands, but nevertheless it can be and is being done. Wherever this device is shown, large crowds gather. It is so fascinating a device that it often became necessary for us to stop the operator so people would move on and let others gather about for a demonstration.

To be factual in such an atomic-power display and, so as not to misinform the audience, we pointed out in our "comic" book that there are "things to come," and in our flow chart that "vast numbers of challenging technical and economic problems confront scientists, engineers, and technicians. Enough problems should be solved at the Knolls Atomic Power Laboratory (operated for the Atomic Energy Commission by General Electric Co., Schenectady, N.Y.) to make electric power experimentally, if not economically, in a few years."

"Will substantial amounts of useful power be available to us in 1965? — 1975? — 2000? The answer will depend on the future of technological, economical, political, and international developments."

Richard C. Robin is on the General Manager's staff of the Nucleonics Department, General Electric Company, Schenectady, N.Y. His duties are in Public Relations and Education. During the last war Mr. Robin, whose training is that of an engineer, was in the Aircraft Gas Turbine Division and was responsible for heading the education program on aircraft turbosuperchargers and jet engines.

V. Westinghouse Theater of Atoms [1]

Richard C. Hitchcock

A blinding flash! An ear-splitting crash! Everybody jumps! We are illustrating nuclear fission; we just smashed a giant plastic model of an atomic nucleus.

Our purpose is (a) to make an interesting show for young and old, (b) to use simple words for the uninitiated,

---

[1] A good lecturer is essential. He should be filled with copious amounts of enthusiasm and correct information. We were extremely fortunate in having as associate lecturers a baker's dozen of seniors in nuclear physics from the College of the City of New York and New York University: Bruce Aaront, Fred Bronstein, Lou Cassotta, Harold Cohen, Bohdan Dobriansky, Sol Feldstein, Jack Israeloff, Herbert Judin, Larry Kaperst, Abraham Kotliar, David Lichtman, Monroe Richman, Erich Scharf. Their good nature was most effective in presenting the Westinghouse Theater of Atoms to appreciative audiences at Grand Central Palace, August 23 to September 19, 1948, during New York's Golden Jubilee Celebration.

and (c) to be accurate in our descriptions so that experts will not be offended.

Our atom model uses two dozen electric-light bulbs, equal numbers of clear (electrons), red (protons), and green (neutrons). Lighted, it is a futuristic Christmas tree, with electrons majestically changing position in rhythmic circles around the sturdy little neutrons and protons closely packed in the stationary nucleus.

We tie in the new words of atomic physics with the picture of the model. We say "the red bulb, a proton, is a plus electric charge; the green bulb, a neutron, has a zero charge." This ties in physics (charge), the color of the bulb in the model, and the new name we want to remember.

Nucleus is a new word to many. It is nuclear explosions that give us the terrific release of energy in this age of atoms. We "shoot the nucleus" rather than "smash the atom," though these mean the same thing.

After shooting the model atom we explain chain reaction by setting off sixty mousetraps, nuclei, each loaded with two rubber stoppers. Each nucleus shoots two more traps. It takes a man ten minutes to set the traps; they clatter into final silence in two seconds. Mousetraps are an extremely close analogy to real nuclear chain reactions.

Then we show a real radiation detector: radioactive nuclei indicate their presence by clicks on a loudspeaker, and also by vertical green lines on the screen of our big tube. If a tool is dangerously radioactive, we bury it. If a man is slightly radioactive, we put him on another job.

To "shoot" nuclei, we have to accelerate particles. The early Geissler tube was used for this. We show a straight glass pipe five feet long, three inches in diameter, and use 50,000 volts. How do we make 50,000 volts understandable? To compare it with a house electric outlet with 110 volts apparently is not clear enough. Everyone has a flashlight. A stack of flashlight cells 1¼ miles high would give 50,000

volts. Then we pump out the air in the tube (rather than "evacuate the tube"). With one tenth of an atmosphere pressure, seven miles straight up in the air, the 50,000 volts makes a pretty purple glow along the five-foot tube. This Geissler tube is the ancestor of today's fluorescent lamp.

Finally we show an up-to-date model of an atom smasher: a Van de Graaf generator with a quarter of a million volts. This represents a six-mile-high pile of flashlight cells.

Did you ever see a 250,000 volt spark? It really is lightning. It crackles and snaps viciously when a four-inch ball approaches the one-foot-diameter dome. But a wire point makes a puny little quarter of an inch spark. The lightning-rod principle is the wire point, and the audience invariably "sees" both points.

Now we look into the future and run the motor of "day-after-tomorrow." A three-foot clear plastic disk with chrome spheres rotates slowly, then faster as it receives and rejects charges from the atom-smasher dome. A possible use of charged nuclei, still in the future, but a better note to strike (we think) than emphasizing the destruction of bombs.

To top off the demonstration, the lecturer sits on the high-voltage dome. Dangerous? Remember the lightning sparks? The lecturer is as safe as a bird on a high-tension wire. The bird cannot be hurt unless he touches both the wire and the ground. The lecturer carefully keeps his feet up in the air, away from the grounded base of the generator. Every part of his body, charged the same, repels every other part. His hair is the easiest to move; each hair moves away from his head. A truly hair-raising stunt! And that closes the performance.

Did we succeed in our purpose? Some people tell us that they came back several times, bringing friends or relatives. Perhaps you are asking, "Is this science or circus"?

We hope it is a happy blend of each. We do not want a dry documentary or mathematical presentation; neither do

we want pure spectacle. Further, the presentation is coherent, each piece of apparatus does something, something easily explained. We deal with atomic nuclei all the way through.

Constant reference to the word, and the action, makes a considerably greater impression than the sum total of the individual demonstrations.

Richard C. Hitchcock is Research Lecturer for the Westinghouse Electric Corporation. He has taught physics at State Teachers College, Indiana, Pennsylvania, and the United States Naval Academy at Annapolis.

PUBLIC OPINION AND THE ATOM

Lillian Wald Kay

A major social issue has emerged in the past three and one-half years. Atomic energy poses problems for our representatives in Congress and the United Nations and for the rest of us who read the newspapers, listen to the radio, participate in community forums, or the more informal discussions around the cracker barrel or in the club car. Nuclear energy challenges psychologists and educators in their professional fields as well as in their roles as citizens. The atomic age has arrived and we must find ways to prepare for its promise as well as to face its problems. Does the state of public opinion indicate readiness for this double task?

Discussions of atomic energy since Hiroshima have centered, for the most part, on the problem of the bomb and its control. That priority is completely understandable. It is further understandable that, of necessity, much about the bomb has been and must be kept secret. There is an acceptance of the necessity for that secrecy which is often accompanied by the feeling that each individual has no responsibility to learn in this field because so much of the technical material is not available. Many people feel that they are justified in avoiding the issue while they hope (and even, some-

times, pray) that the problem of atomic weapons will be solved adequately by the responsible officials. In a recent interview, Chairman Lilienthal of the United States Atomic Energy Commission aptly referred to that situation as "acquiescence in ignorance."[1]

Most of the questions on atomic energy used by the national polling services have dealt with the bomb and problems of international control. An analysis of the results reported by the national polls showed that the trend was one of increasing fear.[2] Typical results center around the point of whether the development of the atomic bomb, and the release of atomic energy, was "good" or "bad." In September 1945, an American Institute of Public Opinion (Gallup Poll) question: "Do you think it was a good thing or a bad thing that the atomic bomb was developed?" showed this distribution of answers:

69 per cent good
17 per cent bad
14 per cent no opinion

When the same question was used again in October 1947, those figures had changed to 55 per cent good, 38 per cent bad, and 7 per cent no opinion.

In February 1947, the National Opinion Research Center used this approach: "In the long run, do you think people everywhere will be better off because somebody learned to split the atom?" It should be noted that this question deals with "splitting the atom" and not specifically with the atomic bomb. The results indicate, however, that by 1947 even this more neutral question was eliciting less optimistic responses:[3]

---

[1] A. MacLeish, "A Progress Report on Atomic Energy," *Life* (September 27, 1948) pp. 114 ff.

[2] L. W. Kay and I. Gitlin, "A Problem in the Development of Opinion and Morale: Atomic Bombs or Atomic Energy?" *Journal of Social Psychology,* XXIX, No. 1 (1949).

[3] These national poll data are from the section "The Quarter's Polls" in the *Public Opinion Quarterly* (fall 1945 to winter 1948).

37 per cent thought people would be better off
38 per cent thought people would be worse off
6 per cent thought it would make no difference
19 per cent didn't know

As has been indicated, the national polls have stressed the weapons aspect. An exhibit stressing the peacetime uses of nuclear energy seemed an excellent opportunity to study opinion and information as well as to investigate the effect of such an exhibit on the people who saw it. Four thousand people were interviewed — 2,000 as they were entering the exhibit, 2,000 as they were leaving it.[4] It is felt that this was an adequate sample of the population visiting the exhibit. It is probably less selected from the point of view of previous interest than would have been the case if Man and the Atom had been shown alone. As the situation stood, there were many exhibits being shown simultaneously at the Grand Central Palace and each visitor could choose whether or not he wanted to see any specific one.

Four questions were asked and then personal data such as sex, age, education, place of residence, and political affiliation (as indicated by presidential choice in 1944) were recorded. The last two were not important in this analysis although, as will be indicated later, in some instances the political question might have been significant.

The first question was: "Which one of these words best describes your feelings when you hear the phrase 'atomic energy'?" A card was presented to the subject on which appeared the words: awe, boredom, fear, guilt, hope, insecure, justified, and secure. This question was designed as

---

[4] The polling was done at the Man and the Atom exhibit when it was displayed as part of the observance of the Golden Jubilee of New York City at Grand Central Palace from August 23 to September 19, 1948. The polling was done by students from the New York City high schools, New York University, and Brooklyn College. The Research and Statistical Service of the National Council of the Boy Scouts of America is responsible for the machine processing of the data.

a refinement of the "good" or "bad" approach. Like the older question it is a way of getting at emotional reaction, but it has two advantages. First, it is more likely to get such a reaction from the people who know that splitting the atom was inevitable. Second, it covers a wider range of emotional response.

The second question, planned to indicate the range of uses known, as well as to test the information given by the exhibit, read: "In what ways do you think atomic energy can be used?" The answers given were classified as: agriculture, industry, medicine and biology, power, and war.

The third question was: "Do you think you should have more information in the things you read and hear about (a) atomic weapons; (b) atomic power; (c) other uses of atomic energy?" It was asked as three discrete questions, *i.e.,* answer to "weapons" recorded before "power" question was asked. The function of this question was to discover whether people are interested in more information. The answers were recorded in such a way as to give data on the proportion of people who did not want more information because of security considerations.

The last question was a combination of information and opinion. The first part was: "Do you know what the United Nations Atomic Energy Commission's plan for the international control of atomic energy is?" If they said that they knew, part two was asked: "Do you approve of it?"

The major comparison undertaken was the "before" and "after" one. All changes or differences reported in this paper are statistically significant.

Man and the Atom reduced fear and insecurity and increased the feeling of hope in relation to atomic energy, as this was measured by the first question:

	Per Cent Before	*Per Cent After*
Fear	20	15
Insecure	15	12
Hope	27	34

The proportion finding no appropriate word remained constant (6 per cent) as did the proportions choosing "guilt" (1 per cent), "justified" (3 per cent), and "secure" (9 per cent).

Man and the Atom transmitted information. Sixteen per cent of the people in the "before" group knew no uses for atomic energy. Only 10 per cent answered "don't know" to the second question in the "after" group. Among those who did know applications the answers (in the two groups) were distributed as follows:

	Per Cent Before	*Per Cent After*
Medicine (and biology)	51	67
Power	49	49
War	42	33
Industry	28	33
Agriculture	6	14

There was a significant increase in each of the peacetime uses except power, and a significant decrease in the mention of weapons. The lack of change in power will be discussed below.

The analysis of the third question is interesting in two respects. The before-after comparison showed a decrease in the number of people concerned about security. Within each sample, however, there is an increase in the number wanting to know more about power over the number wanting to know about weapons, and in the number wanting to know about other uses (presumably medicine) over those interested in power.

The United Nations question showed no differences in the first part. Thirty-three per cent of the "before" and 35 per cent of the "after" group knew the plan. In the "after" group there were more "don't know" answers to the question on approval and fewer "no" answers than in the "before" group.

This summary of the results indicates that Man and the Atom, as it was presented at Grand Central Palace, was successful (in immediate experience) in alleviating fear and in giving information. Two sets of exhibits which did not follow this trend were those dealing with power and international control. In the incoming group, mention of power applications was second only to mention of medicine. This suggests that interest was there for both. Why did one "take" while the other did not? One possibility is that because of the floor plan the power and control exhibits were not shown as effectively as the ones on medicine. This will be tested the next time Man and the Atom is exhibited. The other possibility is that the medical exhibits are more easily understood by the observer to be pertinent to him since it is possible to show that radioactive materials are being used *now* in medicine and biology.

An analysis of such an educational effort must take into account not only the structure and purposes of the exhibit, but also the problem of readiness for viewing it. The immediate effect of Man and the Atom has been shown to be in the direction of satisfying the purposes of those who planned and designed it. There is no way of measuring its long-term effect except in so far as it is known that emotion and value are an essential part of attitude and that changing value and effect are essential to changing attitude. The immediate changes in emotional response justify the prediction that this may have a lasting effect.

There are people, however, who do not come to see such an exhibit. Some of them are too concerned about the dangers of atomic energy. Others feel that it is too difficult a

subject for them to understand — or that it is none of their concern. It is obvious that the fact that Man and the Atom is being shown in their city is no guarantee that they will present themselves to view it. Other devices must be designed to reach such groups and must take into account the need to touch them emotionally as well as intellectually.

Even those who are interested and hopeful enough to go to see what is heralded as the "most comprehensive exhibit of the peacetime uses of atomic energy ever assembled," come with a backlog of older attitudes and frames of reference. A single effort, no matter how authoritative, dramatic, and successful, cannot be depended on to overcome prevailing frames of reference permanently.

All of the mediums of mass communication influence the development of opinion. So do less formal processes such as group discussion. The task is complicated because it has so many facets: the development of interest in the peacetime applications of nuclear energy *and* the development of an intelligent and realistic attitude toward the problems posed by atomic weapons. Never before in history has it been possible to communicate information as rapidly and as dramatically as it can be done today. These resources must all be used in the attempt to develop these two attitudes.

Lillian Wald Kay is an instructor in the Psychology Department, Washington Square College of Arts and Science, New York University. She has been on the research staff of the Columbia University Office of Radio Research, the Boy Scouts of America, and the Commission on Community Interrelations.

ATOMIC POWER AND THE FUTURE

John R. Dunning

The dropping of an atomic bomb on the city of Hiroshima dramatized the opening of the atomic age. The successful test of this weapon at Alamogordo, New Mexico, in July of 1945 was the culmination of the work of 50 years. One might highlight and outline that progress by considering only the major scientific discoveries — the discovery of X rays, the studies of the structure of the nucleus of the atom, the first transmutation by Lord Rutherford in 1919, the demonstration of uranium fission in 1939, the development of chain reactors, etc. Such an overview, however, neglects the fact that the brilliant insights are few and, often, far between. The periods separating them are times of patient research, the importance of which cannot be discounted in evaluating the total result. Any scientific progress depends on such a combination of routine and inspiration. This is usually an exciting story, to the relatively small number of people who are interested. The announcement of the beginning of the atomic age was, however, of different significance. It raised a question for the whole world: is this destruction or Utopia?

The years of the Manhattan Engineer District, which developed the atomic bomb, represented a unique co-operation of science, industry, and government. The size of the project was unusual also. It is estimated that more than two billion dollars were spent in that effort. On the constructive side, it must be remembered that the developments of those years opened the door to future progress. A one-inch cube of uranium ore, if fully converted, has the energy equivalent of 3 or 4 million pounds of coal. A messenger boy can carry the fuel for an entire city in his hand. We have seen this energy used for destruction. We can see it used construc-

tively for power and a more abundant future if we exert the co-ordinated effort required.

The development of atomic energy for peacetime power is a problem which captures the interest and imagination of the physicist and the engineer. The energy is there but can we use it effectively and economically for land-based power stations, ship propulsion, planes, and rockets? Widely divergent views are held on these topics. Atomic energy is entering a new phase. Physics has laid the theoretical and experimental basis but this new field needs the introduction of engineering design and industrial experience if we are to push ahead rapidly. Progress will come through action. We need to judge the actual performance of different basic types of nuclear reactors to judge their practicality, reliability, and economy. More important, we need the experience gained in actual nuclear-power units to tell what the really important problems are. New knowledge, new research may open up new ways to release the enormous energy locked in the nucleus of the atom.

The problems outlined with respect to the development of atomic power will be solved in time as were the problems confronting the scientists who worked on the original release of nuclear energy. In 5 to 20 years, or possibly sooner, terms which were the jargon of the theoretical physicist in the 1930's will be household words. These developments, although they must be carried on with the security precautions necessary for national safety until there is adequate international control of possible destructive uses of atomic energy, will be participated in by a much broader cross section of the population than was involved in the early research. These people, as well as their families and neighbors, at the same time must be educated to understand the possibilities for the future which atomic power will bring. It would seem wise for them to master the essentials of this new energy source in order that they will be familiar with it

and willing to receive it into their homes, factories, hospitals, and power plants. We have the problem of overcoming the fearful associations attached to the early emphasis on destructive uses. We have the advantage of the time during which this power source is being developed to plan a thorough and intelligent educational program.

The atomic age will set new problems for the educator as well as for the engineer. The fact that it will influence the entire community means that education cannot be limited to the classroom and the child. A new power source in the community very well may change many of the existing economic problems. The research necessary for its development may involve further expenditure of public funds. The citizen must understand the problems of national development of atomic energy and international control if he is to vote wisely on these issues. The old lines of academic disciplines and the old techniques of classroom teaching may not prove adequate. This JOURNAL was meant largely to stimulate thinking along the lines of the development of appropriate educational devices. There have been reported here attempts made and problems encountered in educational programs. The educational comic, "Dagwood Splits the Atom," was prepared specifically for the Man and the Atom exhibit. Other mediums of mass communication have adapted their facilities to this problem. Exhibits are helpful, but do they reach the entire community? How do we prepare for them, and, even more important, how do we develop follow-up programs? How can we adapt educational materials to different intellectual levels, different types of communities, different interest groups? All of these must be answered, and in the answering, new problems will arise. The educational facilities of the community must turn to this question so that the constructive and destructive potentials of nuclear energy can be properly dealt with and evaluated. We look forward to a new era of great opportunity where co-opera-

tive effort between areas of human endeavor can bring us all closer to the better life.

John Ray Dunning is Scientific Director of Columbia University. Professor Dunning demonstrated the first uranium fission in the United States in 1939 and the first fission of separated U-235 in 1940. He was director of Research Division I, SAM laboratories from 1942 to 1945.

BIBLIOGRAPHY

Compiled by Israel Light

A. *Bibliographies:*

Crary, R. W., Evans, H. M., Gotlieb, A., and Light, I. *The Challenge of Atomic Energy;* a resource unit and discussion guide for teachers and group leaders. New York: Bureau of Publications, Teachers College, Columbia University, 1948. Pp. 79-92. Contains comprehensive listing of films, filmstrips, recordings, plays, books, and periodical and newspaper references; annotated for school purposes.

Light, Israel. *Annotated Bibliography on Atomic Energy:* 257 selected references for schools and discussion groups. New York: Bureau of Publications, Teachers College, Columbia University, 1947. Pp. 29.
Includes mostly nontechnical material; books, pamphlets, documents, periodicals; special reference to sources to be found in school and college libraries; annotated as to readability, motivation, etc.; items listed by topic for student use in papers.

United Nations, Atomic Energy Commission. *An International Bibliography on Atomic Energy:* political, economic, and social aspects. Vol. I (rev. ed.) Lake Success: United Nations, 1948. Pp. 90. Mimeographed.
Covers all aspects, mostly nonscientific; foreign references; annotated.

United States Library of Congress (J.E. Mason, comp.). *Atomic Energy;* references covering various aspects of the subject, especially the political, military, social, and economic. Arranged topically. Legislative Reference Service, Library of Congress, Washington, D.C.
Monthly mimeographed bulletin from November 1, 1946; annotated; considerable international coverage in addition to U.S. material.

B. *Scientific-technical References:*

Davis, Harry M. *Energy Unlimited;* the electron and atom in everyday life. New York: Murray Hill Books, 1947. Pp. 273.
Covers field of electronics; chapters readable separately; excellent pictures; adult reading and for serious high-school and college-science student.

Eidinoff, M. L. and Ruchlis, H. *Atomics for the Millions.* New York: Whittlesey House, 1947. Pp. 281.
Careful, detailed analysis of nuclear science; diagrams; for good readers.

Hecht, Selig. *Explaining the Atom.* New York: Viking Press, 1947. Pp. 205.
Short and simple; few diagrams but carefully selected; excellent reading for all levels and abilities.

O'Neill, John J. *Almighty Atom;* the real story of atomic energy. New York: Ives Washburn, 1945. Pp. 94.
In form of popularized science lectures; good diagrams; includes chapters on atomic-energy potential.

Smyth, Henry D. *Atomic Energy for Military Purposes;* the official report on the development of the atomic bomb under the auspices of the U. S. Government, 1940-1945. Princeton: Princeton University Press, 1946. Pp. 308.
The original atomic-energy "bible" of the U.S. Government; explanation of scientific problems encountered; "this report is intended to be intelligible to scientists and engineers generally and to other college graduates with a good grounding in physics and chemistry."

C. *Implications of Atomic Energy:*

Air Affairs, An International Quarterly, 1:334-418 (March 1947).
Entire second half devoted to series of articles on various aspects of atomic energy, such as military strategy, international politics, national control, civilian defense, etc., by authorities like Blandy, Mumford, Ogburn, McMahon, and others; good reading for all ages.

Annals of the American Academy of Political and Social Science, 249: 1-176 (January 1947).
Entire issue devoted to "Social Implications of Modern Science"; articles on relation of atomic energy to social change, civil liberties, world government, international control, and

natural resources by outstanding authorities such as Compton, Brodie, Wirth, Ogburn, Cushman, etc.

Brown, Harrison. *Must Destruction Be Our Destiny?* New York: Simon and Schuster, 1946. Pp. 159.
General account divided into two parts, implications for society and especially the government in rejecting international control, and the necessity for a world government; excellent analysis of "Buck Rogers" notions about atomic bomb and its potentialities; excellent reading for all kinds of students and adults.

Coale, Ansley J. *The Problem of Reducing Vulnerability to Atomic Bombs.* Princeton: Princeton University Press, 1947. Pp. 116.
Report prepared for the Committee on the Social and Economic Aspects of Atomic Energy of the Social Science Research Council; study of decentralization of cities and industries as a defense measure against atomic attack; excellent reading.

Cottrell, Leonard S. and Eberhart, Sylvia. *American Opinion on World Affairs in the Atomic Age.* Princeton: Princeton University Press, 1948. Pp. 152.
Statistical survey and interpretation of a poll of some 6,000 people relative to their attitudes toward United Nations and atomic bomb; questions stimulating, and returns illuminating.

Cousins, Norman. *Modern Man Is Obsolete.* New York: Viking Press, 1946. Pp. 59.
Modern classic in its field; short discussion of man's social and ethical shortcomings; obsolescence of current political arrangements; author's view of some form of international government.

Crary, R. W., Evans, H. M., and Hass, C. G. *Operation Atomic Vision:* a teaching-learning unit for high-school students. Washington, D.C.: National Education Association, 1948. Pp. 95.
Excellent brochure outlining major points, scientific and nontechnical, of atomic energy with suggestions for student study, projects, and bibliography.

Hersey, John. *Hiroshima.* New York: A. A. Knopf, 1946. Pp. 117. (Available in 25-cent edition from Bantam Books.)
An account, vivid and personal, of the experiences of selected individuals who survived the Hiroshima atomic-bomb explosion on August 7, 1945; fascinating reading for anyone.

Isard, Walter. "Some Economic Implications of Atomic Energy," *Quarterly Journal of Economics,* 62:202-28 (February 1948).

Analysis of production costs of atomic-energy plant with coal plants; implications for opening new industries and relocation of economic centers; provocative and detailed; for advanced readers.

Lang, Daniel. *Early Tales of the Atomic Age*. New York: Doubleday & Co., 1948. Pp. 223.
Series of articles reprinted from *The New Yorker;* relate to development of Oak Ridge, security measures, committee discussions preceding preparation of Acheson-Lilienthal Report, Los Alamos armaments programs; excellent human interest, "behind the scenes" stories for all students; very simple reading.

Masters, Dexter, and Way, Katherine (eds.). *One World or None*. New York: McGraw-Hill, 1946. Pp. 79.
Short series of articles by world-famous scientists and social scientists on various aspects of atomic energy, such as international control, defense measures, nature of nuclear fission, etc.; some articles difficult reading, others easy; useful for any class.

Newman, James R. and Miller, Byron S. *The Control of Atomic Energy:* a study of its social, economic, and political implications. New York: McGraw-Hill, 1948. Pp. 434.
Analysis in great detail of U. S. Atomic Energy Act; includes documents, atomic-energy glossary, and bibliography; James Newman, counsel of U. S. Senate Special Committee on atomic energy; excellent volume for every purpose; difficult reading, but indispensable as reference.

Schurr, Sam. "Economic Aspects of Atomic Energy as a Source of Power," *Bulletin of the Atomic Scientists,* 3:117-20, 125 (April-May 1947).
Treats relative costs of gas, electricity, and other forms of power in various parts of the world with atomic power; magnitude of effects on standards of living.

United States Atomic Energy Commission. First, Second, Third, and Fourth *Semiannual Report to the Congress*. Washington, D.C.: Government Printing Office, 1947-1948.
Series of reports required by law of Atomic Energy Commission to inform Congress and the people of progress in all fields of atomic-energy research and production. Fourth report especially valuable as a complete story of isotopic research and possibilities to control various diseases eventually through atomic-energy by-products; difficult and specialized reading,

but official, authoritative, and necessary for understanding administration of atomic-energy program in this country.

United States Strategic Bombing Survey. *The Effects of Atomic Bombs on Hiroshima and Nagasaki.* Washington, D.C.: Government Printing Office, 1946. Pp. 47.
Official report, with diagrams, charts, and pictures, of extent and nature of damage in the two Japanese cities attacked with atomic bombs; simple and vivid reading.

D. *International Control and Implications:*

Blackett, P. M. S. *Political and Military Consequences of Atomic Energy.* London: Turnstile Press, 1948. Pp. 200.
The first and only major, comprehensive attack upon the majority stand of the United Nations Atomic Energy Commission relative to current impasse on international control of atomic energy; complicated but provocative reading; essential for understanding Soviet point of view.

Carnegie Endowment for International Peace. "Atomic Energy and American Policy," "The Control of Atomic Energy," "The United Nations and Atomic Energy Commission," *International Conciliation,* Nos. 416 (December 1945), 423 (September 1946), and 430 (April 1947), respectively. Pp. 751-823, 309-438, 167-292.
Reproduction of official documents, resolutions, treaty plans, and excerpts from verbatim records of United Nations discussions of plans for international control of atomic energy; easy reading; source materials; indispensable for class use; sell for 5 cents each.

University of Chicago Law Review. "Atomic Energy for Lawyers; A Symposium." Volume 15, Summer 1948. Pp. 799-908.
Series of six papers by legal counsel for U. S. Senate Atomic Energy Committee, former Director of Patents, and Professors Shils and Lasswell on various aspects of atomic energy; emphasis on international implications of failure to agree on bomb control, and reactions to one year of operation under Atomic Energy Act; adult reading.

Fox, William, T. R. *The Struggle for Atomic Control.* New York: Public Affairs Pamphlet No. 129, 1947. Pp. 32.
Brief and illustrated analysis of factors involved in international control of atomic energy; plans of both sides explained; simple and easy reading.

Higinbotham, William A., and Lindley, Ernest K. *Atomic Challenge.* Headline Series No. 63. New York: Foreign Policy Association, May-June 1947. Pp. 63.
Simply written, illustrated; in two parts, scientific explanation of atomic energy and pro and con of various plans for international control; recommended highly for all grades.

Shils, Edward A. *The Atomic Bomb in World Politics.* London: National Peace Council, 1948. Pp. 79.
Excellent and comprehensive analysis and interpretation of U. S. and U. S. S. R. plans for international control of atomic energy; attempt to interpret Soviet stand in light of their history and philosophy; adult reading but highly rewarding; no similar analysis yet available.

U. S. Department of State. *The International Control of Atomic Energy: Growth of a Policy.* Washington, D.C.: Government Printing Office, 1946. Dept. of State Publication No. 2702. Pp. 281.
Informal summary of official declarations and proposals made to and in United Nations Atomic Energy Commission between August 6, 1945, and October 15, 1946; excellent source book; entire documents and speeches reproduced with analysis included; simply written.

——————. *International Control of Atomic Energy: Policy at the Crossroads.* Washington, D.C.: Government Printing Office, 1948. Dept. of State Publication No. 3161. Pp. 251.
Same as preceding reference, bring record down from October 15, 1946, to May 17, 1948; includes excellent analysis of Soviet stand on majority proposals; easy reading.

——————. First, Second, and Third *Report of the United Nations Atomic Energy Commission to the Security Council,* December 31, 1947; September 11, 1947; May 17, 1948, respectively. Washington, D.C.: Government Printing Office, 1947-1948. Dept. of State Publication Nos. 2737, 2932, 3179, respectively. Pp. 101, 106, 78.

Israel Light is a former special consultant to the United Nations Atomic Energy Commission group. He is author and co-author of several bibliographies and teaching units on atomic energy.

ATOMIC ENERGY — PROBLEMS OF INTERNATIONAL CONTROL

A Film Strip

The United Nations Department of Public Information, Films and Visual Information Division has produced a film strip explaining the problems of international control. The film strip is designed for college and adult groups. In order to facilitate the presentation of the complex problems involved it deals mainly with the proposals of the United States and those of the Soviet Union. It consists of three parts: (1) Formation of the United Nations Atomic Energy Commission (terms of reference); (2) The Proposals; (3) Review. A script and discussion leader's guide are available. The complete film strip affords those interested in the problems raised by the discovery of atomic energy an opportunity to study a summary presentation of the main proposals voiced before the United Nations Atomic Energy Commission during the past two years. The film strip is distributed free of charge upon written application to the United Nations Department of Public Information, Lake Success, N.Y., by interested organizations throughout the world and may be retained permanently for re-use.